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(71) Applicant: **AT&T Corp.**
New York, NY 10013-2412 (US)

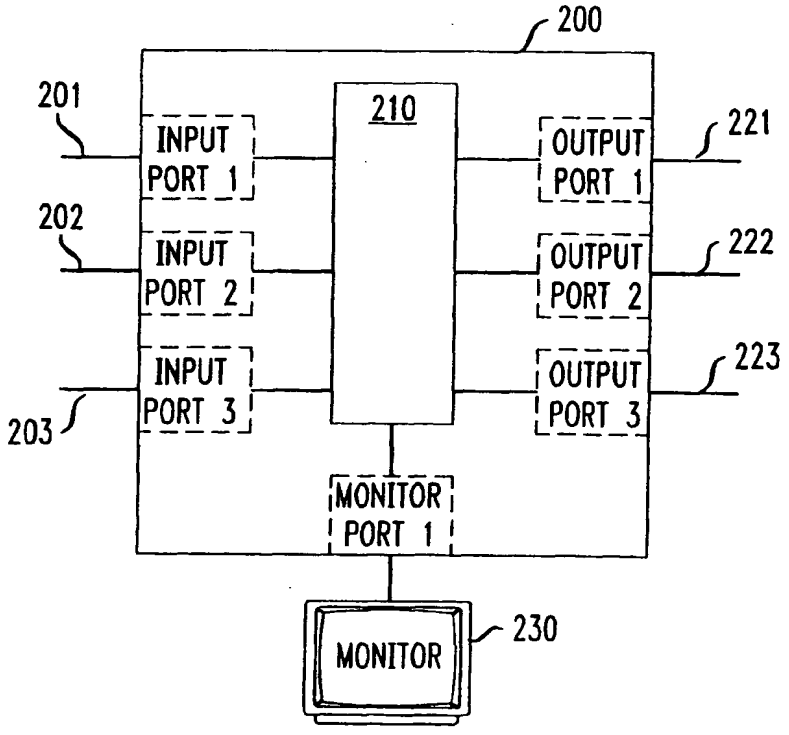
(72) Inventor: **Ramakrishnan, Kadangode K.**
Berkeley Heights, New Jersey 07922 (US)

(74) Representative: **Harding, Richard Patrick et al**
Marks & Clerk,
4220 Nash Court,
Oxford Business Park South
Oxford OX4 2RU (GB)

(54) Promiscuous network monitoring utilizing multicasting within a switch

(57) Multicasting within a switch is utilized to promiscuously monitor switched communication networks. The switch routes data packets from input ports to data output ports and routes copies of the data packets to a monitor output port. A monitor processor is connected to the switch to receive copies of all data packets received at the switch, and thereby monitor the communication network.

FIG. 3



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ports' data packet copies are routed to which monitor output ports. Of course, the present invention can be configured with more than two monitor output ports.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a prior art approach for promiscuous monitoring of a communication network.

Fig. 2 shows a wide area network illustrative of the configuration and operation of a contemporary communications network.

Fig. 3 illustrates a switch and promiscuous monitor according to an embodiment of the present invention.

Fig. 4 illustrates a multicasting routing methodology to perform promiscuous monitoring within the switch shown in Fig. 3.

Figs. 5A and 5B shows a switch with multiple monitor output ports according to a second embodiment of the present invention.

Fig. 6 shows a switch with multiple monitor output ports and output port-based monitoring according to a third embodiment of the present invention.

DETAILED DESCRIPTION

Networks are a principal means of exchanging or transferring information (e.g., data, voice, text, video, etc.) among communications devices (i.e., devices for inputting and/or outputting information such as computer terminals, multimedia workstations, fax machines, printers, servers, telephones, videophones, etc.) connected to the network(s). A network typically comprises switching nodes connected to each other, and to communication devices, by links.

Fig. 2 shows a wide area network illustrative of the configuration and operation of a contemporary communications network. Network 10 comprises a plurality of switching nodes 20 and links 30. Each of the switching nodes 20 may also have associated therewith a buffer of predetermined size and each of the links 30 will have associated therewith a predetermined traffic handling capacity. Note that the depiction of a network comprising only five switching nodes is for convenience of illustration, and that an operating network may have a much larger number of switching nodes and associated connecting links.

Various switching nodes are shown illustratively connected to communications devices 40. It should be understood that the single communications devices shown connected to the switching nodes in the figure are used for simplicity of illustration, and that an actual implementation of such a network would ordinarily have a number of communications devices connected at such switching nodes. Note, as well, that the illustrated communications devices may also represent another network, such as a LAN, which is connected to network 10.

Each communications device 40 generates information for use by, or receives information from, other communications devices in the network. The term "information" as used herein is intended to include data, text, voice, video, etc. Information from communications device 40 is characterized by a set of transmission and/or rate parameters related to network link and buffer requirements needed to accommodate transmission of such information. Control information can be communicated from communication device 40 to a switch at switching node 20 to specify the rate/buffer requirements.

Communications networks will often use a networking protocol called Asynchronous Transfer Mode (ATM). In these networks, all communication at the ATM layer is in terms of fixed-size information segments, called "cells" in ATM terminology. An ATM cell consists of 48 bytes of payload and 5 bytes for the ATM-layer header. Routing of cells is accomplished through cell switches. Packets of information may be broken up (or segmented) into multiple cells, each cell carrying the 48 bytes of information sequentially. The destination reassembles the cells received into the original packet.

ATM cells can be carried on a virtual circuit (VC) that must be set up such that received cells can be routed to multiple ports at a switch. Permanent VC connections can be easily set up through switch management; switched VC connections, however, need to be set up on a more dynamic basis.

Fig. 3 illustrates a switch and promiscuous monitor according to an embodiment of the present invention. As shown in Fig. 3, switch 200 has three input ports, three data output ports, and a monitor output port. Although switch 200 shown in Fig. 3 has a certain number of ports for illustrative purposes, the present invention is equally applicable for any switch having any number of ports.

Input links 201, 202 and 203 are connected to switch 200 at input ports 1, 2 and 3, respectively, which are connected to interconnection network 210. Interconnection network 210 is connected to data output ports 1, 2 and 3. Output links 221, 222 and 223 are connected to data output ports 1, 2 and 3, respectively. Interconnection network 210 is also connected to monitor port 1 which is connected to promiscuous monitor processor 230.

Interconnection network 210 routes data packets received at an input port to the appropriate destination data output port(s). The number of input ports and/or output ports for switch 200 can exceed the number of links of the network connected to switch 200. Additional output ports therefore are available for connecting one or more promiscuous monitors. In addition to switching communication data packets between the input ports and the data output ports, interconnection network 210 also routes a copy of data packets received at each input port or output port to the monitor output port 1 through the use of known point-to-multipoint multicasting techniques within a single switch. Point-to-multipoint multicasting is the routing of a single message to multiple

being utilized. The present invention is equally applicable for any type of switch, such as an input-buffered switch, output-buffered switch and shared-memory switch.

Claims

1. A switch, within a switched communication network, for enabling promiscuous monitoring, comprising:

   a plurality of input ports including a first input port, said plurality of input ports receiving a plurality of data packets including a first data packet and a second data packet;
   a plurality of data output ports including a first data output port and a second data output port;
   a first monitor output port; and
   an interconnection network connected to i) said plurality of input ports, ii) said plurality of output ports, and iii) said first monitor output port, said interconnection network routing the first data packet from the first input port to the first data output port, said interconnection network routing a copy of the first data packet to said first monitor output port.

2. The switch of claim 1, wherein a copy of each data packet of the plurality of data packets is routed to said first monitor output port.

3. The switch of claim 1, wherein a copy of a subset of the plurality of data packets is routed to said first monitor output port.

4. The switch of claim 1, wherein said interconnection network routes a copy of each data packet received at the first input port to said first monitor output port.

5. The switch of claim 1, wherein said interconnection network selects a subset of the plurality of data packets received at the first input port and routes a copy of the subset to said first monitor output port.

6. The switch of claim 5, wherein said interconnection network selects the subset on a dynamic basis.

7. The switch of claim 5, wherein said interconnection network selects the subset on a virtual circuit basis.

8. The switch of claim 1, wherein said interconnection network routes to said first monitor output port a copy of each data packet forwarded to the first data output port.

9. The switch of claim 1, wherein said interconnection network selects a subset of the plurality of data packets forwarded to the first data output port and routes a copy of the subset to said first monitor output port.

10. The switch of claim 9, wherein said interconnection network selects the subset on a dynamic basis.

11. The switch of claim 9, wherein said interconnection network selects the subset on a virtual circuit basis.

12. The switch of claim 1, further comprising:

    a second monitor output port connected to said interconnection network;
    said interconnection network routes the second data packet from the second input port to the second data output port and routes a copy of the second data packet to said second monitor output port.

13. The switch of claim 12, wherein said interconnection network selects a first subset of the plurality of data packets and routes a copy of the first subset to said first monitor output port, said interconnection network selects a second subset of the plurality of data packets and routes a copy of the second subset to said second monitor output port.

14. The switch of claim 13, wherein said interconnection network balances the load between data packets routed to said first monitor output port and data packets routed to said second monitor output port.

15. The switch of claim 13, wherein said interconnection network selects the first subset or second subset on a dynamic basis.

16. The switch of claim 13, wherein said interconnection network selects the first subset or second subset on a virtual circuit basis.

FIG. 3

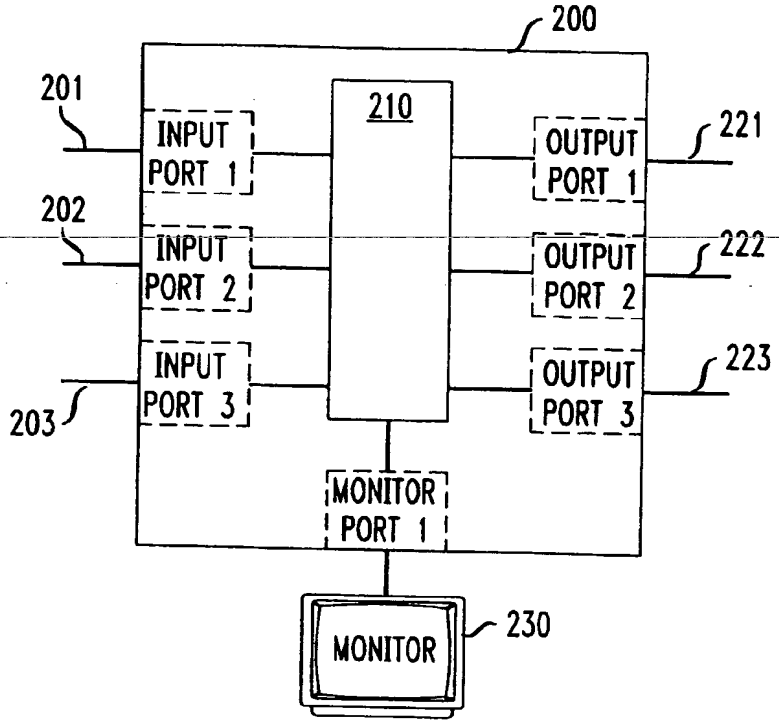


FIG. 4

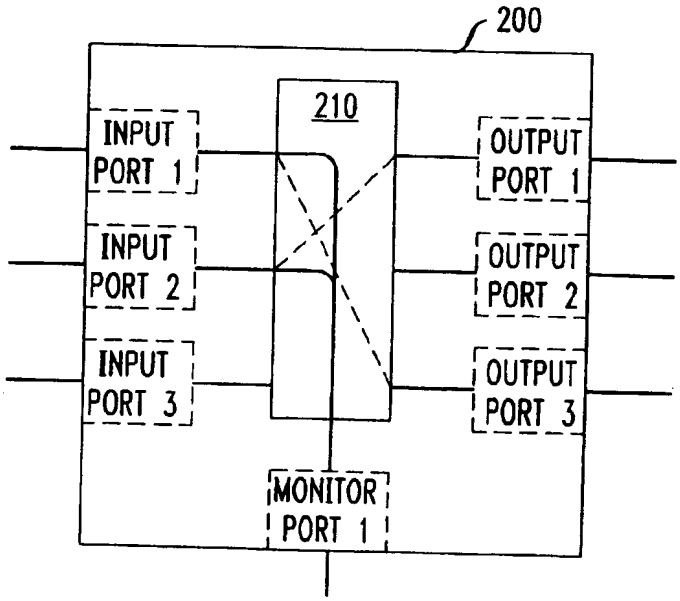
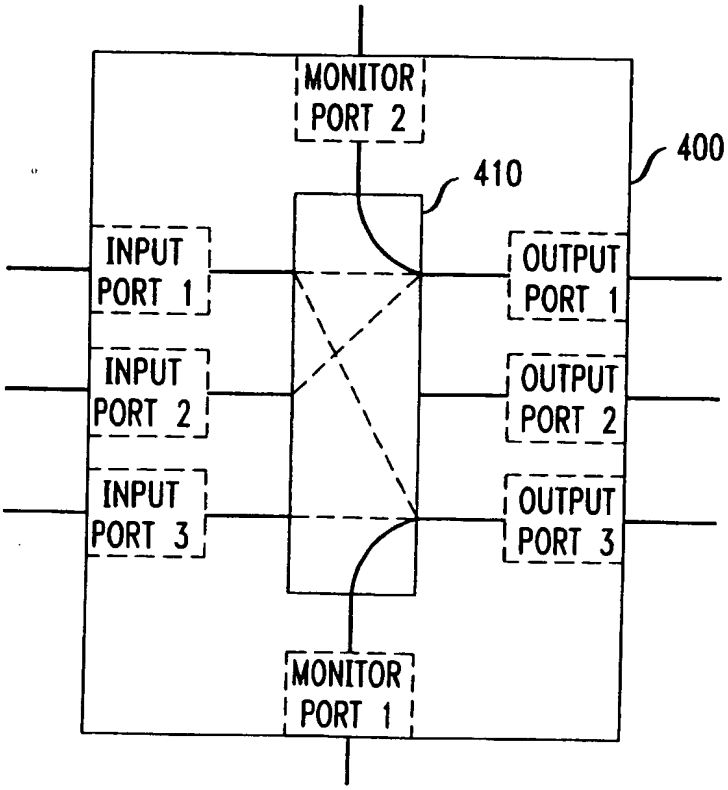


FIG. 6



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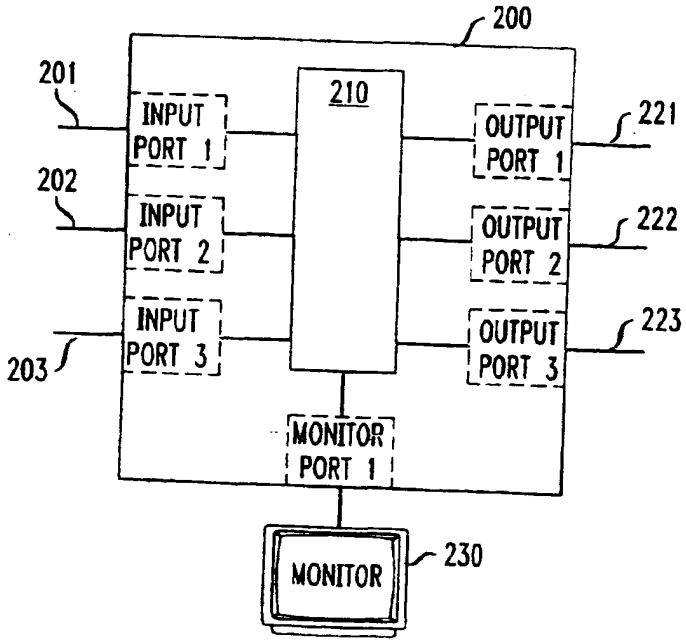

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EUROPEAN SEARCH REPORT

Application Number
EP 97 30 8622

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	ITOH A ET AL: "FUNCTION TEST METHODS USING TEST CELLS FOR ATM SWITCHING SYSTEM" COMMUNICATIONS - GATEWAY TO GLOBALIZATION. PROCEEDINGS OF THE CONFERENCE ON COMMUNICATIONS, SEATTLE, JUNE 18 - 22, 1995, vol. 2, 18 June 1995, pages 982-987, XP000533145 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS * the whole document * ---	1	
P,X	"Remote Monitoring MIB extensions for ATM networks" THE ATM FORUM TECHNICAL COMITTEE: , 1 May 1997, XP002097455 FTP://FTP.ATMFORUM.COM/PUB/APPROVED-SPECS/AF-NM-TEST-0080.000.pdf * paragraph 3.4 * -----	1-11	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 March 1999	Staessen, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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